

ATTACHMENT 6
(per Addendum No. 8)

VE20-051

Option 5

**Increased Capacity Energy Storage System
with Geofencing**



**Massachusetts Bay
Transportation Authority**

Increased Capacity Energy Storage System with Geofencing (Option 5)

In order to further reduce carbon footprint and increase full economy, the Authority wishes to take advantage of the latest in battery development and hybrid systems technology to upgrade of the Energy Storage System (ESS) with geofencing capabilities on the 60 forty-foot Hybrid bus fleet.

The bus shall meet all performance standards, design criteria, and configuration validation requirements, as outlined in this Technical Specification.

The Contractor shall work closely and forge a relationship with the bus manufacturer, existing hybrid drive system OEM, and other component OEMs, to optimize systems' efficiencies while developing strategies for weight control and fitment to the existing bus structure and meet bus performance requirements.

The bus shall meet the following minimum performance requirements:

1. Bus operation in full electric mode (powered off upgraded Energy Storage System) for no less than 3 engine-off continuous miles based upon Manhattan duty cycle and the bus operating with a full electric load.
2. Shall be equipped with a Geofencing system including:
 - a. The propulsions system shall integrate a Geofencing system to control the operating condition of the system. The system shall be able to enable, disable, or automatically enter the vehicle into an extended engine off zero-emissions operation mode if all required operating conditions are met.
 - b. Arrive and Go capability that allows for additional EV operation while entering to and exiting a stop. With Arrive and Go, the hybrid system allows the bus to approach and pull away from stop fully electric before re-engaging the engine. This feature shall be programmable to activate at a set low speed or with geospatial coordinates for passenger bus stops.
 - c. The Geofencing system shall require no input from the vehicle operator during routine use. However, the contractor shall provide means for the operator to engage and disable the engine off zero-emissions operation mode.
 - d. The Geofencing system shall have an interface that can be utilized by the Authority to modify the locations and operating conditions. The system shall also incorporate features that ensure that the vehicle location continues to be tracked even in difficult environments where satellite signals may not be present. The Geofencing system shall be configurable by the Authority and updates sent to the fleet wirelessly.
 - e. The software licensing/subscriptions required to implement and maintain this Geofencing system shall be provided for 6 years from delivery of the final production bus.

The Contractor shall also meet the following requirements:

1. Retrofit shall not adversely affect OEM structural and component OEM warranties.
2. Provide an appropriate artificial sound generator automatically activated when the bus is in engine off zero-emissions operation mode. Contractor shall demonstrate the artificial sound generator and document the exterior vehicle noise (pull away and approach) when the bus is operating in zero emissions mode.
3. Meet all FMVSS, State, and local regulations.

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Technical Specification No. VE20-051 for the Midlife Overhaul of 60 Forty-foot Hybrid Buses

4. Upgraded Energy Storage System and associated components shall be designed to meet all performance requirements for up to 6 years.

As part of the Design Review Process, the Contractor shall provide:

1. Provide a cost/benefit/technical analysis of incremental increase of engine off continuous miles between engine run cycles.
2. Analysis of engine run time required to return ESS to sufficient state of charge to meet continuous engine off distance requirement.
3. Proposed bus ESS life expectancy, no less than 300,000 miles or 8 years
4. Full documentation including electrical and mechanical drawings, design and configuration calculations, and complete bill of materials

As part of this option, the Contractor shall install and integrate an increased capacity Energy Storage System (ESS) with geofencing solution. This includes materials procurement; and installation of new equipment and all related subcomponents including cables, harnesses, connectors, mounts, and hardware. The Contractor is responsible for all costs associated with software and hardware updates/modifications for the complete integration of the new ESS and geofencing solution.

The Pilot Bus and four (4) serial production buses shall be outfitted with data loggers designed to monitor bus performance, provide fault detection, monitor major system components, and retain timestamped data. The system must be able to monitor major system component cycling and operating conditions and be capable of providing data in a format useful for component life cycle analysis.

The Contractor and propulsion system supplier shall instrument and monitor these vehicles in revenue service and provide analysis assistance and monthly reports, or as requested by the Authority. Each vehicle shall be monitored for a minimum period of 6 years.

The Contractor shall be responsible for performing validation testing at their facility as part of the Pilot Bus program. The Contractor will provide technical support to perform on-route testing in the MBTA service area for a minimum of one month following the return of the Pilot bus to the Authority.